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STUDIES ON EFFECT OF DIFFERENT PACKAGING MATERIAL AND STORAGE TEMPERATURES ON POST-HARVEST SHELF LIFE AND QUALITY OF ARILS OF POMEGRANATE CV. BHAGWA

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ABSTRACT

This study investigated the effect of packaging and storage temperatures, on the post harvest shelf life and quality of arils of pomegranate cv. Bagwig. Arils packed in polypropylene modular mate (PPMM), recorded the minimum physiological loss in weight (PLW) (2.78%) with high TSS (15.23°Brix), acidity (0.40%), percent total sugar (9.68) and ascorbic acid (7.53 mg 100g^{-1}). With respect to storage temperatures, arils stored at 1°C recorded minimum PLW (2.20%) with high TSS (15.40°Brix) and acidity (0.42%), percent total sugars (9.90), ascorbic acid content (8.26 mg 100g^{-1}). The interaction effects between packaging and storage temperatures, revealed that the minimum PLW (1.97%) coupled with high TSS (15.50°Brix), acidity (0.44%), percent total sugars (10.27), ascorbic acid content (8.56mg 100g^{-1}), were observed in arils packed in PPMM +1°C.

KEYWORDS: Arils, Packing Material & Storage Temperature

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Original Article

INTRODUCTION

Pomegranate (*Punic granite* L.) is one of the favorite fruits of tropical and subtropical regions, where it has enjoyed the consumer's patronage for its nutritious and therapeutic properties, as it contains vitamin C, phenols and anthocyanins, which act as antioxidants and protects the human body from oxidative stress (Zaouay *et al*. 2012) and also prevent diseases, such as coronary heart diseases and some types of cancer. Pomegranate is a super food and has been spreading rapidly, among people who are constantly looking for natural products to meet the emerging challenges of many lifestyle diseases. Several processed products viz. Pomegranate juice, wine, candy, anardana, carbonated drinks, syrup and tea are found to be very high value products in the International market, particularly due to its neutraceutical properties. India is one of the leading pomegranate producing

country. As per 3rd advance estimate, Indian Horticulture Database 2015-16, pomegranate is cultivated in an area of 1.93 lakh hectares with an estimated production of 21.93 lakh tonnes. The Pomegranate is commercially grown for its sweet acidic taste. In spite of the numerous health benefits, pomegranate consumption is still limited, due to the difficulties of extracting the arils from the fruit and, the irritation of phenolic metabolites which stain the hands during preparation of seeds (Gil *et al*., 1996b) and also requires adequate knowledge of the fruit mechanical properties such as toughness, firmness, cutting force and shear strength (Ekrami-Rad, Khazaei, & Khoshtaghaza, 2011). Hence, minimally processed pomegranate fruit (ready-to-eat arils), presents a more appealing produce to consumers than whole fruit (Ergun & Ergun, 2009) and increases the prospect of production and consumption of pomegranate. In order to meet the consumers present demand for natural, fresh, flavourish, convenient and high quality ready-to-eat pomegranate arils, various processing techniques have been developed among which, minimal processing and modified atmosphere packaging along with low temperature storage are being increasingly employed to extend the shelf life of arils by maintaining the quality. Package and storage go hand in hand. Storage of products is influenced by the kind of packaging material used besides storage temperatures. Packaging protects the arils, serves as an alternative measure for controlling diseases and provides structural support for convenient storage and transport. Various storage and packaging applications have been under study by research workers for safe storage of pomegranate arils of different varieties. Many types of packaging material have been used which include polypropylene (PP), low density polyethylene (LDPE), high density polyethylene (HDPE), metalized polyester (MP) bags, heat seal trays with oriented polypropylene film (OPPF), rigid polystyrene vessels (RPV), perforated polypropylene trays (PPT), polyethylene terephthalate packs (PETP), polyethylene standing pouch (PESP), polypropylene modular mates (PPMM) *etc*. The principle underlying low temperature storage is to slow down the physiological and biochemical activities of the stored produce. Refrigeration is the only known economical method for safe storage of fruits and fruit products. At present, the main impediment in pomegranate ready-to-eat arils trade is short shelf life, losing their sensory and microbial quality quickly after removing from the fruit, and the only one way to extend the storage period of arils sufficiently for longer period without affecting their quality, is by use of proper packaging material and storing at ideal temperature.

MATERIAL AND METHODS

The experiment was conducted at Post-Harvest Technology Laboratory, College of Horticulture (COH), Anantharajupeta, YSR Kadapa district, Andhra Pradesh during the year, 2015. Fruits of pomegranate Cv. Bagwig used in the experiment were obtained from AICRP centre on Arid Zone fruits, Horticultural Research Station, Rekulakunta, Ananthapuramu district, Andhra Pradesh. The experiment was conducted in a completely randomized design replicated thrice with 3 packaging materials viz., PESP (P_1), PETP (P_2) and PPMM (P_3) and storage temperatures S_1 (1°C), S_2 (4°C), S_3 (8°C) and S_3 (room temperature). The following shelf life parameters were analyzed statistically and results were presented.

Total Soluble Solids

Total soluble solids were found out by using Erma Hand Refractometer (0 to 32°Brix) and expressed in °Brix A.O.A.C. (1975).

Physiological Loss in Weight

For determining the Physiological loss in weight (PLW) (%), arils were weighed before imposing the treatment

and noted as the initial weight. The loss in weight was recorded at four days interval up to sixteen days which served as the final weight. The PLW of arils was determined by using the following formula and expressed as percentage.

$$\text{PLW (\%)} = \frac{\text{initial weight of arils (g)} - \text{final weight of arils(g)}}{\text{initial weight of arils (g)}} \times 100$$

Total Soluble Solids

The Total soluble solids (TSS) (°Brix) content of arils was determined by ERMA hand refractro-meter. A drop of juice obtained from arils was placed on prism of the refractro-meter and observed the coincidence of shadow of the sample with the reading on the scale and expressed as °Brix (Ranganna, 1986).

Titratable Acidity

Titratable acidity (%) of pomegranate juice was determined by the method proposed by Ranganna (1986). In this method, 5ml of water was added to 5mlaril juice and mixed thoroughly. The sample solution was titrated against 0.1N NaOH using phenolphthalein as indicator. Appearance of light pink color denotes the end point. The acidity of aril juice was expressed in per cent.

Total Sugars

The total sugars (%) were estimated by A.O.A.C method (1980). Ten ml of pomegranate aril juice was taken into 100ml conical flask and 10 ml of distilled water was added. Five ml of 6N HCl was added to the contents and kept in a hot water bath at 70°C for exactly eight minutes. After that, the flask was removed from water bath and cooled to room temperature. The excess acidity was neutralized by adding 40% sodium hydroxide to the conical flask using phenolphthalein as indicator. This was indicated by the formation of pink colour. Then the solution was made upto 100ml by using distilled water and then filtered. The filtrate was taken into a burette and titrated against 10 ml of Fehling solution (5ml of both A and B) in hot condition using methylene blue as indicator, and continued the titration till the brick red colour precipitate is formed. Titre value was noted and the percentage of total sugars was estimated by using the factor, 10ml of Fehling solution = 0.05g glucose.

Ascorbic Acid

Ascorbic acid (mg $100g^{-1}$) was estimated as per the procedure outlined by Ranganna (1986). Ten grams of pomegranate arils juice was taken in a 100 ml volumetric flask and the volume was made up with 3 % Meta phosphoric acid. Ten millilitre of the aliquot was taken and titrated with standard dye (2, 6, dichlorophenol indophenol dye) until it attains pink red. The ascorbic acid was estimated and expressed as mg ascorbic acid 100 g^{-1}.

Statistical Analysis

The data was analyzed statistically using factorial completely randomized design as per the procedure outlined by Panse and Sukhatme (1985), results were discussed and valid conclusions were drawn only on significant differences between treatments mean at 5% level of significance.

RESULTS AND DISCUSSIONS

Physiological Loss in Weight (PLW) (%)

The PLW (%) of arils of Bagwig cultivar as influenced by packing material and storage temperatures are

presented in Table 1. Significant differences were observed among packing material and storage temperatures. There was a gradual increase in PLW (%) of arils with increase in storage period. The lowest PLW (%) of arils was recorded in P_3 (PPMM) (0.78, 1.20, 1.69 and 2.78) whereas; the highest PLW (%) was recorded in P_2 (PETP) (1.56, 2.43, 2.98 and 3.85) during the storage period of 4, 8, 12 and 16 days. The lowest PLW (%) of arils packed in PPMM (P3) might be due to reduction in rate of respiration as reported by Nanda *et al*. (2001) and Bhatia *et al*. (2013) in pomegranate and highest PLW (%) in PETP (P_2) might be due to increase in the rate of respiration as reported by Ghatge *et al*. (2005) in pomegranate. Among storage temperatures, a temperature of 1°C (S1) recorded lowest PLW (%) of 0.42, 1.12, 1.62 and 2.20 whereas, highest PLW (%) of 2.80, 3.32, 4.18 and 5.49 was recorded with room temperature(S4) during the storage period of 4, 8, 12 and 16 days respectively leading to shriveling and loss of turgidity of arils. The lowest PLW (%) of arils in S_1 (1°C) could be attributed to less moisture loss due to minimum metabolic activity at low temperatures. These results are in agreement with the findings of Garg *et al*. (1976) in mango, Jain and Chauhan (1995) in kinnow mandarin, Navistar *et al*. (1995) in beer and Raja Krishna Reddy *et al*. (1999) in sweet orange.

Interaction effect of packaging material and storage temperatures was significant with respect to PLW (%) of arils of Bagwig cultivar. Significantly lowest PLW (%) of arils was observed in P_3S_1 (PPMM + 1°C) (0.15, 0.69, 1.18 and 1.97) and the highest PLW (%) of arils was observed in P_2S_4 (PETP + room temperature) (3.56, 4.13, 4.97 and 6.15). Low PLW (%) of arils in P_3S_1 (PPMM and 1°C) is due to reduced metabolic activity and less permeability of gaseous exchange with PPMM package and low temperatures. The present findings are in agreement with the previous findings of Sandhu and Singh (2000) in pear, Nanda *et al*. (2001) and Bhatia *et al*. (2013) in pomegranate.

TSS (°Brix)

The data pertaining to TSS (°Brix) of arils as influenced by packing material and storage temperatures are presented in Table 2. Significant differences were observed among packing material and storage temperatures with respect to TSS (°Brix). The minimum TSS (°Brix) was recorded in arils packed in PPMM (P_3) (15.51, 15.65 and 15.59) whereas, maximum TSS (°Brix) was recorded in arils packed in PETP (P_2) (15.78, 15.93 and 15.82) at 4^{th}, 8^{th} and 12^{th} day of storage, respectively. However on 16^{th} day, the maximum TSS (°Brix) was observed in P_3 (15.23) and minimum TSS (°Brix) in P_2 (15.01). With regard to storage temperatures, S_1 (1°C) recorded the lowest TSS (°Brix)(15.34, 15.44 and 15.60) and S_4 (room temperature) recorded the highest TSS (°Brix)(16.03, 16.24 and 15.60) during 4^{th}, 8^{th} and 12^{th} day of storage. On 16^{th} day, the maximum TSS (°Brix) was observed in S_1 (1°C) (15.40) while, minimum TSS (°Brix) was observed in S_4 (room temperature) (14.80).

The interaction effect of packing material and storage temperatures on TSS (°Brix) of arils revealed that, on 4^{th} day of storage, significantly lowest TSS (15.23°Brix) was recorded in PPMM + 1°C (P_3S_1) and highest TSS (16.30°Brix) was recorded in PETP + room temperature (P_2S_4) in Bagwig cultivar. The interaction effect was non-significant on 8^{th}, 12^{th} and 16^{th} day of storage. It could be noticed from the data that, the TSS (°Brix) was found to increase initially and later on decreased as the storage period progressed. The increase in TSS (°Brix) during the initial stages may be attributed to the conversion of starches and other polysaccharides into sugars or increased respiration and transpiration as reported by Buhler and Farmhand (1980) in Kinnow mandarin. Randhawa *et al*. (2009) also reported that, increased TSS (°Brix) was due to dehydration but the decrease in TSS (°Brix) at the end of storage might be due to higher rate of fermentation as evidenced by the development of off flavours in Kinnow mandarin. The decrease in TSS (°Brix) due to increased rate of respiration in advanced stage of storage was also reported by Mukherjee and Dutta (1967) in Guava.

Titratable Acidity (%)

The per cent titratable acidity of arils packed in different packing material and stored at different temperatures are presented in Table 3. The acidity was recorded high in arils packed in PPMM (P_3) (0.45, 0.44, 0.42 and 0.40) and it was low in PETP (P2) packed arils (0.42, 0.40, 0.37 and 0.35) on 4^{th},8^{th},12^{th} and 16^{th} day of storage in Bagwig cultivar. The decrease in acidity in packaged materials might be due to higher CO_2 concentration in the packages (Vines and Obserbacher, 1961) which decreased the rate of respiration in grapefruit (Peteracek *et al*. 1998). Similar results were also reported by Hussain *et al*. (1982) in citrus and Nanda *et al*. (2001) in pomegranate. The maintenance of higher acidity in Modular mate pack may be due to decreased hydrolysis of organic acids and subsequent accumulation of organic acids, which were oxidized at a slow rate because of decreased respiration in pomegranate (Nazmy *et al*. 2012). There were significant differences among storage temperatures with respect to acidity on all days of storage. Significantly highest acidity was noticed in arils stored at S_1 (1°C) (0.48, 0.46, 0.44 and 0.42) whereas, the lowest acidity was noticed at S_4 (room temperature) (0.35, 0.33, 0.31 and 0.29).

The interaction between packing material and storage temperatures on acidity of arils showed that on 4^{th} day, significantly highest acidity was recorded in PPMM + 1°C (P_3S_1) (0.49) while, lowest acidity was observed in PETP + room temperature (P_2S_4) (0.33).Whereas, on 8^{th} and 16^{th} day of storage, the highest acidity was noticed in P_3S_1 (0.47 and 0.44) and lowest acidity in P_2S_4 (0.31 and 0.27). The interaction effect was non-significant with respect to this trait on 12^{th} day of storage only. The acidity would differ depending on the cultivar, growing region, and storage conditions in pomegranate as reported by Gil *et al*. (1996) and Martinez *et al*. (2012). The high variability in acidity at different temperatures could be due to moisture loss resulting in increased organic acid concentration with increase in temperatures as opined by Gil *et al*. (1996), Artes *et al*. (2000b) and Martinez *et al*. (2012) in pomegranate. Due to conversion of acids to sugars as indicated by Pool *et al*. (1972) in Grapes cv. Thompson seedless.

Total Sugars

In the present study, significant differences were observed among different packing material and storage temperatures and their interaction effects on per cent total sugars of the arils (Table 4). On 4^{th} and 8^{th} day of storage, total sugars were significantly low in arils packed in PPMM (P_3) (11.77 and 12.27) whereas, high total sugars were recorded in PETP (P_2) packed arils (12.70 and 13.28). However, on 12^{th} and 16^{th} day of storage, the total sugars were maximum in arils (9.94 and 9.68) packed in PPMM (P_3) and minimum in PETP (P_2) packed arils (9.27 and 9.03). Similar observations were reported by Bhushan *et al*. (2002) in Kiwi fruit, Singh and Narayana (1999) in mango, Mohla *et al*. (2005) in Sand pear, Jadhao *et al*. (2007) in Kagzi lime and Sonkar *et al*. (2009) in Kinnow mandarin. The declining trend in total sugars at later stage due to utilization of sugars as a substrate in metabolic process was reported by Rocha *et al*. (2003) in apple cv. Jonagored. With respect to storage temperatures, significantly lowest total sugars was observed at S_1 (1°C) (11.17 and 11.71) while, highest total sugars was observed at S_4 (room temperature) (13.49 and 14.07) in arils of Bagwig on 4^{th} and 8^{th} day of storage respectively. Whereas, on 12^{th} and 16^{th} day, the higher total sugar was observed at S_1 (10.25 and 09.90) and lower total sugars was observed at S_4 (8.79 and 8.61). The slow rate of increase in total sugars of arils packed in packing materials might be due to slow physiological and metabolic changes, and also due to slow conversion of starch into sugars (Nanda *et al*. (2001) in pomegranate and Keditsu *et al*. (2003) in Khasi mandarin).

The results of interaction effect were indicated that packing material and storage temperature on total sugars (%) of arils was found to be non-significant on 4^{th} day of storage. Whereas, on 8^{th} day of storage, significantly lowest total

sugars was recorded in PPMM +1°C (P_3S_1) (11.20) and highest total sugars in PETP and room temperature (P_2S_4) (14.43). On 12th and 16th day of storage, highest total sugars (%) was observed in P_3S_1 (10.27) and lowest total sugars in P_2S_4 (8.11)..

Ascorbic Acid (mg 100g^{-1})

The Ascorbic acid (mg 100g^{-1}) content of arils was significantly influenced by the packing material and storage temperatures as depicted in Table 5. On 4th, 8th, 12th and 16th day of storage, significantly highest ascorbic acid content (mg 100g^{-1}) was observed in PPMM (P_3) (9.76, 8.89, 8.09and 7.53) while, lowest ascorbic acid content (mg 100g^{-1}) was recorded in arils packed in PETP (P_2) (9.06, 8.13, 7.68 and 7.01). The retention of ascorbic acid content in packing material can be attributed to moisture retention and higher CO_2 concentration in the packages (Vines and Obserbacher *et al*.1961) which have decreased the rate of respiration in grapefruit (Peteracek *et al*.1998) and subsequently slowing down the overall senescence process in persimon (Min *et al*.1977). Among the storage temperatures, highest ascorbic acid content (mg 100g^{-1}) was recorded at S_1 (1°C) (10.72, 9.56, 8.95 and 8.26) whereas, lowest ascorbic acid content(mg 100g^{-1}) was recorded at S_4(room temperature)(8.03, 7.42, 6.94 and 6.47) during the entire period of storage. The ascorbic acid content in arils showed a general declining trend in all packing material and storage temperatures. However, the decrease was more pronounced at room temperatures as compared to other storage temperatures due to increased rate of metabolic activity. The decrease in ascorbic acid content of arils was less rapid in PPMM packaged arils stored at lower temperatures (S_1, S_2 and S_3) compared to room temperature (S_4) storage. This might be due to partly degradation of ascorbic acid through oxidation, reduced enzymatic oxidation at low O_2 and high CO_2 levels as reported by Valero and Serrano (2010) and Siddiqui *et al.* (2011) in Broccoli. Higher ascorbic acid content in arils stored at S_1 (1°C) might be due to its slow rate of degradation. Similar findings were observed by Ram *et al*. (1970) in Kagzi lime, Hussain *et al*. (2000) in Green peppers, Mahajan *et al*. (2005) in Kinnow mandarin, Singh and Rao (2005) in Papaya and Githiga (2012) in Mango under MAP.

Interaction effect of packing material and storage temperatures with respect to ascorbic acid content of arils was non-significant throughout the storage period.

CONCLUSIONS

Based on the results obtained from the study, it is concluded that, arils of pomegranate cv. Bagwig packed in polypropylene modular mate (PPMM) and stored at temperature of 1°C recorded less physiological loss in weight and retained appreciable nutritional quality at the end of storage period of sixteen days.

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APPENDICES

Table 1: Effect of Different Packing Material and Storage Temperatures on Physiological Loss in Weight (PLW) (%) of Arils of Pomegranate cv. Bagwig

PLW (%) Storage Period (Days)	0	4				8				12				16			
		P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean
S_1	0.0	0.44	0.67	0.15	0.42	0.97	1.69	0.69	1.12	1.56	2.10	1.18	1.62	2.10	2.51	1.97	2.20
S_2	0.0	0.54	0.82	0.31	0.56	1.23	1.51	0.77	1.17	2.00	2.13	1.36	1.83	2.62	3.21	2.31	2.71
S_3	0.0	0.97	1.18	0.77	0.97	1.79	2.38	1.18	1.79	2.21	2.72	1.54	2.15	2.74	3.51	2.31	2.85
S_4	0.0	2.97	3.56	1.87	2.80	3.67	4.13	2.15	3.32	4.87	4.97	2.69	4.18	5.77	6.15	4.54	5.49
Mean	0.0	1.23	1.56	0.78		1.92	2.43	1.20		2.66	2.98	1.69		3.31	3.85	2.78	
		S. Em±		CD@P=0.05		S. Em±		CD@P=0.05		S. Em±		CD@P=0.05		S. Em±		CD@P=0.05	
P		0.05		0.15		0.06		0.19		0.04		0.12		0.06		0.18	
S		0.06		0.17		0.07		0.22		0.05		0.14		0.07		0.21	
P×S		0.10		0.29		0.13		0.38		0.08		0.25		0.12		0.36	

Table 2: Effect of Different Packing Material and Storage Temperatures on TSS (^{0}Brix) of Arils of Pomegranate cv. Bagwig

TSS (^{0}Brix) Storage Period (Days)	0	4				8				12				16			
		P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean
S_1	15.20	15.33	15.50	15.20	15.34	15.40	15.57	15.37	15.44	15.63	15.67	15.50	15.60	15.37	15.33	15.50	15.40
S_2	15.20	15.43	15.67	15.40	15.50	15.70	15.77	15.53	15.67	15.70	15.87	15.57	15.71	15.13	15.03	15.33	15.17
S_3	15.20	15.63	15.70	15.57	15.63	15.83	15.93	15.63	15.80	15.87	16.00	15.87	15.91	15.03	14.97	15.17	15.06
S_4	15.20	16.00	16.23	15.87	16.03	16.23	16.43	16.07	16.24	15.63	15.73	15.43	15.60	14.77	14.70	14.93	14.80
Mean	15.20	15.60	15.78	15.51		15.79	15.93	15.65		15.71	15.82	15.59		15.08	15.01	15.23	
Statistics		S. Em±		CD@P=0.05		S. Em±		CD@P=0.05		S. Em±		CD@P=0.05		S. Em±		CD@P=0.05	
P		0.02		0.05		0.02		0.05		0.02		0.05		0.02		0.05	
S		0.02		0.06		0.02		0.06		0.02		0.06		0.02		0.06	
P×S		0.03		0.10		0.03		NS		0.04		NS		0.03		NS	

Table 3: Titratable Acidity (%) of Arils of Pomegranate cv. Bagwig as Influenced by Different Packing Material and Temperatures

Titratable Acidity (%) Storage Period (Days)	0	4				8				12				16			
		P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean
S_1	0.50	0.48	0.47	0.49	0.48	0.47	0.45	0.47	0.46	0.44	0.42	0.46	0.44	0.42	0.39	0.44	0.42
S_2	0.50	0.46	0.44	0.47	0.46	0.45	0.43	0.47	0.45	0.43	0.41	0.44	0.42	0.39	0.38	0.44	0.40
S_3	0.50	0.45	0.43	0.45	0.44	0.42	0.41	0.44	0.42	0.42	0.37	0.43	0.41	0.39	0.35	0.39	0.38
S_4	0.50	0.34	0.33	0.38	0.35	0.32	0.31	0.36	0.33	0.30	0.28	0.34	0.31	0.29	0.27	0.31	0.29
Mean	0.50	0.43	0.42	0.45		0.41	0.40	0.44		0.40	0.37	0.42		0.37	0.35	0.40	
Statistics		S. Em±		CD@P=0.05		S. Em±		CD@P=0.05		S. Em±		CD@P=0.05		S. Em±		CD@P=0.05	
P		0.003		0.008		0.002		0.007		0.004		0.013		0.002		0.007	
S		0.003		0.009		0.003		0.008		0.005		0.015		0.003		0.008	
P×S		0.005		0.016		0.005		0.013		0.009		NS		0.005		0.014	

Table 4: Effect of Different Packing Material and Storage Temperatures on Total Sugars (%) of Arils of Pomegranate cv. Bagwig

Total Sugars (%)																	
Storage Period (Days)																	
	0	4				8				12				16			
		P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean
S_1	12.20	11.20	11.37	10.95	11.17	11.72	12.20	11.20	11.71	10.20	10.14	10.42	10.25	9.87	9.55	10.27	9.90
S_2	12.20	11.91	12.10	11.20	11.73	12.51	12.71	11.54	12.25	10.00	9.56	10.20	9.92	9.49	9.32	9.74	9.52
S_3	12.20	12.72	13.30	12.01	12.68	13.28	13.76	12.71	13.25	9.62	9.15	9.93	9.57	9.32	9.15	9.55	9.34
S_4	12.20	13.51	14.02	12.93	13.49	14.15	14.43	13.64	14.07	8.93	8.25	9.20	8.79	8.57	8.11	9.15	8.61
Mean	12.20	12.34	12.70	11.77		12.91	13.28	12.27		9.69	9.27	9.94		9.31	9.03	9.68	
Statistics		S. Em±		CD@P=0.05		S. Em±		CD@P=0.05		S. Em±		CD@P=0.05		S. Em±		CD@P=0.05	
P		0.09		0.28		0.06		0.18		0.05		0.14		0.03		0.09	
S		0.11		0.32		0.07		0.21		0.05		0.16		0.04		0.11	
P×S		0.19		NS		0.13		0.37		0.09		0.27		0.06		0.18	

Table 5: Effect of Different Packing Material and Storage Temperatures on Ascorbic Acid Content (mg 100 g^{-1}) of Arils of Pomegranate cv. Bagwig

Ascorbic Acid Content (mg 100g^{-1})																	
Storage Period (DAYS)																	
	0	4				8				12				16			
		P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean
S_1	11.59	10.58	10.57	11.00	10.72	9.76	8.95	9.96	9.56	9.12	8.54	9.18	8.95	8.49	7.73	8.56	8.26
S_2	11.59	9.76	9.15	10.17	9.69	9.32	8.34	9.41	9.02	8.13	7.93	8.34	8.13	7.32	7.32	7.52	7.39
S_3	11.59	9.15	8.74	9.56	9.15	8.51	8.13	8.57	8.40	7.52	7.52	7.73	7.59	7.12	7.00	7.32	7.15
S_4	11.59	8.00	7.79	8.30	8.03	7.52	7.12	7.63	7.42	7.00	6.71	7.12	6.94	6.71	6.00	6.71	6.47
Mean	11.59	9.37	9.06	9.76		8.78	8.13	8.89		7.94	7.68	8.09		7.41	7.01	7.53	
Statistics		S. Em±		CD@P=0.05		S. Em±		CD@P=0.05		S. Em±		CD@P=0.05		S. Em±		CD@P=0.05	
P		0.11		0.32		0.09		0.26		0.10		0.30		0.11		0.33	
S		0.13		0.37		0.10		0.30		0.12		0.34		0.13		0.38	
P×S		0.22		NS		0.18		NS		0.20		NS		0.23		NS	

Table 6

P_1	-	PESP	S_1	-	1°C	P	-	Packing material
P_2	-	PETP	S_2	-	4°C	S	-	Storage temperature
P_3	-	PPMM	S_3	-	8°C	P×S	-	Interaction between packing material and storage temperature
			S_4	-	Room temperature			